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Indian Standard

SPECIFICATION FOR UNSUPPORTED FLEXIBLE POLYVINYL CHILORIDE SHEETING

(First Revision)

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MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 7 *October* 1981

Indian Standard
SPECIFICATION FOR UNSUPPORTED FLEXIBLE POLYVINYL CHILORIDE SHEETING
(First Revision)

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(*Continued on page* 31)

Indian Standard
SPECIFICATION FOR UNSUPPORTED FLEXIBLE POLYVINYL CHLORIDE SHEETING
(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 12 January 1981, after the draft finalized by the Plastics Sectional Committee had been approved by the Petroleum, Coal and Related Products Division Council.

0.2 Unsupported flexible polyvinyl chloride sheeting is manufactured from polymer of vinyl chloride or copolymer of which the major constituent is vinyl chloride. Such material should be suitably compounded with plasticizers, stabilizers and then converted into sheeting.

0.3 In this revision the test for extensibility after heat ageing has been dropped since it was found to be unrealistic.

0.4 In the preparation of this standard, assistance has been derived from the following standards:

ASTM D 1593-61 Standard specification for non-rigid vinyl chloride plastic sheeting. American Society for Testing and Materials.

BS 1763 : 1967 Thin PVC sheeting (flexible, unsupported) metric units. British Standards Institution.

BS 2739 : 1956 Thick PVC sheeting (flexible, unsupported) metric units. British Standards Institution.

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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*Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard prescribes the requirements, methods of sampling and test for unsupported flexible polyvinyl chloride sheeting.

1.2 This standard covers unsupported flexible polyvinyl chloride sheeting, namely, for general purpose (printed and unprinted), laminated and unlaminated, plain and embossed.

2. TYPES

2.1 The material shall be of two types:

Type 1 — Thin unsupported flexible polyvinyl chloride sheeting, nominal thickness usually in the range of 0 07 to 0·25 mm; and

Type 2 — Thick unsupported flexible polyvinyl chloride sheeting, nominal thickness 0·26 to 1·00 mm.

3. TERMINOLOGY

3.1 For the purpose of this standard, definitions given in IS : 2828-1964* shall apply.

4. REQUIREMENTS

4.1 **Appearance** — The material of Types 1 and 2 when placed and carefully examined on flat illuminated surface, suitable for showing up defects shall be free from bubbles or blisters, creases of permanent nature, streaks, pin holes, particles of foreign matter, undispersed raw material and visual defects. Edges shall be smooth and free from cuts. Embossed sheeting shall have a design uniformly applied. Printed sheeting shall have the print-design uniformly applied. In addition the print shall be free from smudges, blotches and similar defects. The back of the sheeting shall be free from transferred print.

4.1.1 The extent of the above defects permissible shall be as agreed to between the purchaser and the supplier.

4.2 **Average Gravimetric Thickness and Difference from Nominal Thickness** — The average gravimetric thickness of the material of Types 1 and 2 shall be determined in accordance with the method described in Appendix A. When measured according to the method described in A-1, the average gravimetric thickness shall not differ from the nominal thickness by more than 10 percent for unembossed and 12·5 percent for embossed material. When measured according to the method described in A-2, the average gravimetric thickness shall not differ from the nominal thickness by more than 5 percent for unembossed and 7·5 percent for embossed material.

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*Glossary of terms used in plastics industry.

4.3 Tensile Strength and Elongation at Break — When measured in accordance with the method described in Appendix B, the longitudinal and the transverse strength of material shall be not less than 140 kg/cm^2 for Type 1 and 120 kg/cm^2 for Type 2. The longitudinal and transverse elongation at break shall be not less than 200 percent for Type 1 and 150 percent for Type 2.

4.3.1 In case of deep embossing and stiff-feel material, the minimum elongation at break shall be as agreed to between the purchaser and the supplier.

4.4 Tear Strength — The tear strength of material of Types 1 and 2 shall be determined in accordance with the method described in Appendix C. When measured in accordance with the method described in C-1, the tear strength in the longitudinal and transverse directions for the material of Types 1 and 2 shall be not less than 40 kg/cm thickness in each direction. In case of deep embossing, the minimum requirement of tear strength shall be 25 kg/cm. In case of tear strength outside the range of Elmondorf tear strength, method described in C-2 may be used.

4.5 Colour Bleeding — There shall be no staining or marking of the control sample or the filter paper when the material of Types 1 and 2 is tested in accordance with the method described in Appendix D.

4.6 Colour Fastness to Light — For determination of colour fastness to light of the material, either of the following tests may be used.

4.6.1 *Accelerated Fading Test* — Appendix E-1.

4.6.2 *Colour Fastness to Daylight* — Appendix E-2.

NOTE — The material of Types 1 and 2, when tested as prescribed in E-1 and E-2, shall be considered satisfactory when colour fastness of any test piece shall be rated not less than No. 5 of the Light Standard Patterns of plain dyed woollen fabrics as prescribed in IS: 686-1957*. Effect on printing shall be observed in case of printed material.

4.6.3 There are certain shades of which light fastness rating No. 5 cannot be attained. In case where such shades are required, the light fastness rating shall be subject to agreement between the purchaser and the supplier.

4.7 Adhesion of Plies in Laminated Sheets — When tested as described in Appendix F, the material of Types 1 and 2 shall show no separation of plies.

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*Methods for determination of colour fastness of textile materials to daylight.

4.8 Dimensional Stability — When tested in accordance with the method described in Appendix G, the change in dimensions shall not exceed 2 percent.

4.9 Adhesion of Print for Printed Sheets — When examined as described in Appendix H, the number of cycles to remove either the printed pattern or any area of printed material shall be greater than five (10 strokes of abrading member).

4.9.1 In case of metallic and white printing inks, adhesion of print shall be subject to agreement between the purchaser and the supplier.

4.10 Blocking Test — When tested in accordance with the method described in Appendix J, the material shall be readily separable into individual layers and shall not show blocking.

4.11 Optional Requirements

4.11.1 *Retention of Embossed Surface for Embossed Sheets* — The embossed surface shall not show appreciable loss of depth of design when tested as agreed to between the purchaser and supplier.

4.11.2 *Determination of Pin Holes* — When tested in accordance with the method described in Appendix K, the tolerable number of pin holes per sq metre shall be subject to agreement between the purchaser and the supplier.

4.11.3 *Resistance to Cold* — The material shall withstand a bending test around 6 mm diameter steel mandrel without cracking after exposure of one hour at 0°C or lower temperature as agreed to between the purchaser and the supplier.

5. PACKING AND MARKING

5.1 Packing — A roll of unsupported flexible polyvinyl chloride sheeting complying with this standard may contain cuts. The cuts shall be signalled. The number of cuts and the minimum length of each piece shall be as agreed to between the purchaser and the supplier.

5.1.1 Any consignment shall not have more than 25 percent material containing cuts. The material shall be securely packed so as to ensure safe transportation.

5.2 Marking

5.2.1 Sheeting supplied in accordance with this Indian Standard shall bear a label giving the following information:

a) Name and type of the material;

b) Name and/or trade mark of manufacturer;

c) Nominal thickness, width, length and/or net mass, colour, printing , lamination and embossing details of sheeting; and

d) Batch number and date of manufacture.

5.2.2 It is recommended that further information as to the nature, properties and use of flexible PVC sheeting shall be made available to users. A suitable informative labelling is indicated in Appendix L.

5.3 BIS Certification Marking

The product may also be marked with Standard Mark.

5.3.1 The use of the Standard Mark is governed by the provisions of Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

6. STORAGE

6.1 The roll of unsupported flexible polyvinyl chloride sheeting complying with this standard shall be stored vertically on dry, clean, firm level ground and at recommended temperatures in accordance with the manufacturer's instructions. The rolls shall be protected from dust, moisture, direct sunlight, corrosive and solvent fumes.

7. SAMPLING

7.1 For testing, a full width representative sample of sheeting, sufficient for carrying out tests shall be taken, marking the longitudinal direction on the sample. The sample shall be preserved, rolled on a core of adequate diameter, away from any other plastics material that may cause contamination.

7.2 In any consignment all the rolls of unsupported flexible polyvinyl chloride sheeting of the same type, colour and finish shall be grouped together and each group shall constitute a lot (roll is normally about 50 metre length of the sheeting).

7.3 The conformity of the lot to the requirements of this specification shall be ascertained for each lot separately. The number of rolls to be selected at random for this purpose shall be in accordance with Table 1.

TABLE 1 SCALE OF SAMPLING

(*Clause* 7.3)

LOT SIZE N	NO. OF ROLLS TO BE SELECTED n
Up to 100	1
101 to 500	2
501 and above	3

7.4 The rolls shall be selected at random and to ensure randomness of selection, the following procedure is recommended for use:

> Arrange all the rolls in the lot in a systematic manner and starting from any one, count them as 1, 2, ..., etc, up to r and so on, when r is the integral part of N/n (N being the lot size and n the number of rolls to be selected). Every rth roll thus counted shall be withdrawn till the requisite number of rolls is obtained.

7.5 The lot shall be declared as conforming to specification for various characteristics referred in this specification if for each of the characteristics the test results on all the individual specimens are found to be within limits of the specification.

7.6 If the specimens, taken from the sample, fail in one or more tests, each such test shall be repeated twice. For this purpose, two more samples shall be taken from the roll, and the specimens cut from each of them so that duplicate tests may be conducted in respect of each failure. If all the specimens pass the duplicate tests, the lot shall be declared conforming to the specification, otherwise not.

APPENDIX A

(*Clause* 4.2)

DETERMINATION OF AVERAGE GRAVIMETRIC THICKNESS AND ITS DIFFERENCE FROM NOMINAL THICKNESS

A-0. GENERAL

A-0.1 The average gravimetric thickness and its difference from nominal thickness shall be determined by either of the two methods, method A and method B, described in A-1, and A-2 respectively, as agreed to between the purchaser and the supplier.

A-1. METHOD A

A-1.1 Cut three samples, each about 2 000 to 2 500 mm^2 in area and weigh them in air. Take a non-absorbent thread or wire, and suspend the sample by the thread or wire, and weigh with the sample immersed under water maintained at 27 ± 2°C, then weigh only the thread or wire in water (the depth of immersion in water in the two weighings being exactly the same). Care shall be taken to see that no air bubbles adhere to the thread or wire or film while weighing under water.

NOTE — All weighings shall be accurate to 1 percent of the mass.

A-1.1.1 Calculate the specific gravity (S) as below:

$$\text{Specific gravity} (S) = \frac{A}{A - (C - B)}$$

where

A = mass in g of the test piece in air,

C = mass in g of the test piece and the thread or wire in water, and

B = mass in g of the thread or wire in water.

The average of the three results expressed to the nearest 0·01 shall be taken as the specific gravity.

A-1.2 Cut three test pieces, each having an area of 2 500 mm^2 and all of exactly the same length and width from positions approximately equally spaced across the width of the sample at two places about 1 m apart in longitudinal direction. Weigh the test pieces and calculate the average mass (M).

A-1.3 Calculation

A-1.3.1 Calculate the average gravimetric thickness to the nearest 0·002 5 mm as below:

$$\text{Average gravimetric thickness (mm)} = \frac{10 \times M}{S \times L \times B}$$

where

M = average mass in g of the test piece,

S = specific gravity as determined in **A-1.1.1**,

L = length in cm of the test piece, and

B = width in cm of the test piece.

A-1.3.2 From the value of the average gravimetric thickness obtained in **A-1.3.1**, calculate the percent difference from the nominal thickness of the material.

A-2. METHOD B

A-2.1 Procedure

A-2.1.1 Determine the specific gravity of the material as prescribed in **A-1.1** and **A-1.1.1**.

A-2.1.2 Cut a piece of the material about 10 m long. Measure accurately the length and the average width of the roll to 100 mm. Weigh the roll to 0·25 kg accurately.

A-2.2 Calculation

A-2.2.1 Calculate the average gravimetric thickness to the nearest 0·002 5 mm as below:

$$\text{Average gravimetric thickness (mm)} = \frac{100 \times M}{S \times L \times B}$$

where

M = mass in g of the roll,
S = specific gravity of the material as determined in **A-1.1.1**,
L = length in m of the roll, and
B = average width in mm of the roll.

A-2.2.2 From the value of average gravimetric thickness obtained in **A-2.2.1**, calculate the percent difference from the nominal thickness of the material.

APPENDIX B

(*Clause* 4.3)

DETERMINATION OF TENSILE STRENGTH AND ELONGATION AT BREAK

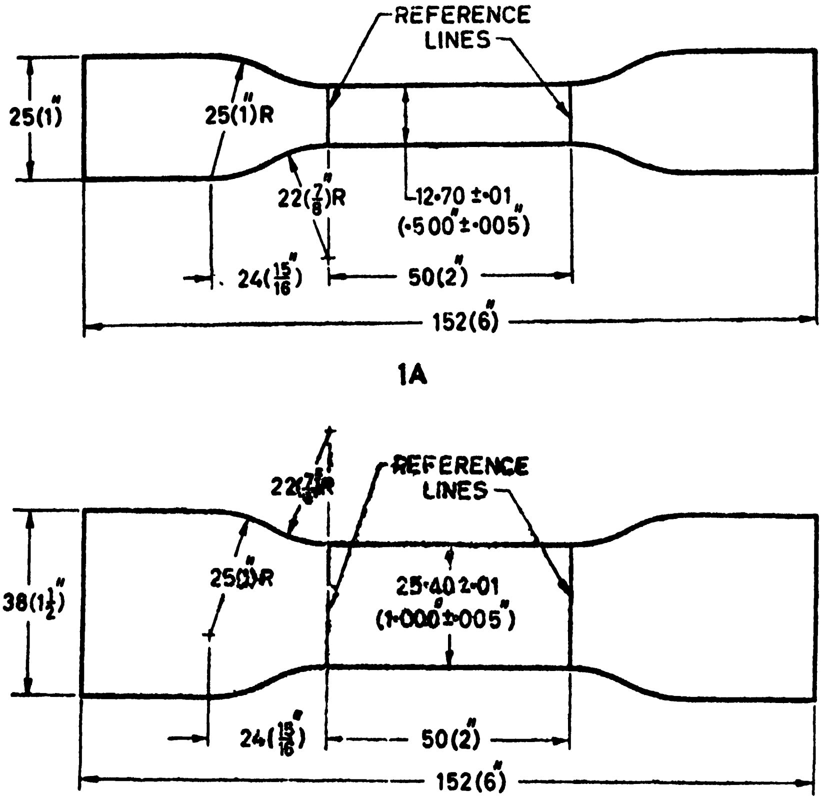
B-1. APPARATUS

B-1.1 Tensile Testing Machine — The tensile testing machine employed shall maintain a rate of movement of one grip which should be as constant as possible, the mean value of the speed of separation as 250 ± 10 percent mm per minute. The load scale shall be accurate to within 1 percent or 0·1 kg whichever is greater. The load range shall be such that the breaking load of the test pieces falls between 15 percent to 85 percent of the maximum on the scale.

Note — It is recommended that the load scale be calibrated at least once every twelve months, using dead weights added successively.

B-2. PREPARATION OF TEST PIECES

B-2.1 Five test pieces shall be cut from the sample in the longitudinal direction and a further five in the transverse direction by punching the appropriate die using a single stroke of a press. The sample shall be supported on a slightly yielding material like leather, rubber or cardboard having a smooth surface, on a flat rigid base. The die used shall be in accordance with Fig. 1A except when a wider test piece is needed to comply with load limitations given in **B-1.1**, the die shall be in accordance with Fig. 1B. Reference lines marked on the test pieces as shown in the figures either with a marker or a glass pencil should be very fine. The average gravimetric thickness of the material as determined in Appendix A shall be taken as the thickness of the test piece.



1A

1B

(Dimensions outside the parentheses are in millimetres)

FIG. 1 DIES FOR TENSILE STRENGTH TEST PIECE

B-3. PROCEDURE

B-3.1 The test pieces shall be conditioned for 3 hours at a temperature of 27 ± 2°C and clamped in the machine at their widened ends. They shall be extended at the rate of 250 ± 10 percent mm per minute and the load and elongation at the moment of break recorded. Test pieces breaking outside the reference lines shall be disregarded and the test repeated.

B-4. CALCULATION AND REPORT

B-4.1 Tensile Strength — The tensile strength shall be calculated in kg/cm^2 from the original area of cross section, calculated from the average gravimetric thickness as determined in Appendix A and the width before elongation and the load required to break the test piece. The mean of five results shall be expressed for the longitudinal and transverse samples.

B-4.2 Elongation at Break — Elongation at break shall be expressed as percentage of the original length between the reference lines. The mean of five results shall be expressed for the longitudinal and transverse samples.

NOTE — If any specimen breaks within 10 mm of a line of contact of either of the jaws, record the result, but if it is found to have broken at a load less than 75 percent of the average of the remainder of the specimens, do not use it in calculating tensile strength, but test another specimen.

APPENDIX C

(*Clause* 4.4)

DETERMINATION OF TEAR STRENGTH

C-1. DETERMINATION OF TEAR STRENGTH (Within the Range of Elmondorf Tear Strength Machine)

C-1.1 Apparatus

C-1.1.1 The test shall be carried out on an Elmondorf type tear testing machine. It shall be provided with a sharp blade capable of producing a well-defined slit in the specimen as described in **C-1.4.3**.

C-1.2 Preparation of Test Pieces

C-1.2.1 The requisite number of test pieces shall be cut from the sample in each direction. Each test piece shall be 75 mm in length and 63 mm in width. For longitudinal tear strength determination, the test piece shall be cut with their width in the longitudinal direction of the sample and similarly for transverse tear strength determination, the test pieces shall be cut with their width in the transverse direction of the sample. The edges of the test pieces shall be free from any nicks and burrs.

C-1.3 Conditioning

C-1.3.1 All the test pieces shall be conditioned at 27 ± 2°C for not less than one hour before testing.

C-1.4 Procedure

C-1.4.1 Tests shall be carried out at 27 ± 2°C.

C-1.4.2 Before making tests the zero setting and level of the machine shall be checked and if necessary adjusted in accordance with the machine manufacturers instructions. The test shall be carried out so that the tearing load falls between 20 percent and 80 percent of the maximum on the scale. To ensure this, a check test specimen from each direction of the sample shall be torn, the result being ignored for report purposes. If the tearing load of the single test piece falls outside the specified range of the scale, two or more test pieces superimposed but not bonded shall be tested at the same time. In that case, sufficient test pieces shall be cut from the sample to enable five groups of test pieces to be tested for each direction.

C-1.4.3 The test piece made up of one or more individual test pieces shall be clamped between the jaws of the testing machine with its (their) upper edge(s) in the same plane as the top of the jaws. A sharp well-defined slit 20 mm in length shall then be made along the line bisecting the test piece along its longer side at right angles to the jaws, by means of the cutting blade fixed on the machine. The test piece shall then be subjected to the tear test by releasing the pendulum so that it acts on the test piece. The reading on the scale and the number of pieces used in a single test shall be recorded.

C-1.5 Calculation and Report

C-1.5.1 *Calculation* — Tear strength shall be calculated in terms of force in kilogram per centimetre thickness of the test piece, as given below:

$$\text{Tear strength (kg/cm)} = \frac{A}{B \times C}$$

where

A = force in kg,

B = number of test pieces comprising the test specimen, and

C = average gravimetric thickness of the sample as obtained in Appendix A.

C-1.5.2 *Report* — The mean of the five results shall be reported for the longitudinal and transverse samples.

C-2. DETERMINATION OF TEAR STRENGTH (Outside Elmondorf Machine Range)

C-2.1 Apparatus

C-2.1.1 *Tensile Testing Machine* — An autographic tensile testing machine shall be used with constant rate of jaw separation of 300 ± 30 mm per min. The load range of the testing machine shall be chosen to suit the particular sheet to be tested so that the tearing load measured falls between 15 percent and 85 percent of the maximum on the scale. The load scale shall be accurate to within 1 percent or 0·1 kg whichever is greater.

C-2.2 Preparation of Test Pieces — Three rectangular test pieces 200 × 50 mm shall be cut from the sample, one from the centre and one from each of the longitudinal edges but not within 50 mm from the edge of the sample. The 200 mm length shall be parallel to the longitudinal direction of the sheeting.

A single cut 75 mm long shall be made in the longitudinal axis of each test piece to form two 25 mm wide legs.

C-2.3 Procedure — The test piece shall be conditioned for not less than 1 hour at 27 ± 2°C before testing. The jaws of the tensile testing machine shall be set 75 mm apart, and if it is equipped with a rack and paws to arrest the downward swing of the pendulum, the paws shall be made inoperative by securing them clear of the rack. An autographic chart shall be wrapped tightly around the recorder drum and slipped in position and the agreement between the dial and the chart readings of load shall be checked.

The first test piece shall then be clamped squarely with one leg in the head-stock grip and the other in the traversing grip so that both leg lengths between the jaws are approximately equal. The recorder pen shall then be placed in contact with the chart. The traversing grip shall be set in motion and a record of the load fluctuations as the tear proceeds for 75 mm shall be obtained. The other two test pieces shall be tested in the same way.

The test shall be carried out at 27 ± 2°C.

C-2.4 Calculation and Expression of Report — The trace obtained consists of a slow rise followed by an undulating plateau, until the sample is broken. The tear strength for the test piece shall be taken as the value of the horizontal median drawn through the plateau region. Each median value shall be divided by the gravimetric thickness of the test piece to give tear strength in kilogram per centimetre thickness. The mean of the results obtained for the three test pieces shall be quoted in kg/cm as the longitudinal tear strength of the sample. If the tear is more than 5 mm away from the central line, the specimen shall be considered not tearable in that direction and the test shall be repeated with three test pieces cut in the transverse direction.

APPENDIX D

(*Clause* 4.5)

TEST FOR COLOUR BLEEDING

D-1. TEST PIECE

D-1.1 The test piece shall be 50 mm square. In cases where more than one colour/printing ink is present, as many test specimens as necessary to ensure that all colours/printing inks are tested shall be used. The test specimens shall be so placed during the test that all colours/printing inks are in good contact with clear control sample, when sandwiched.

D-2. PROCEDURE

D-2.1 Place the test piece on top of a 75 mm square control sample which shall be a clear transparent polyvinyl chloride sheeting of the following formulation:

Polyvinyl chloride	100	parts by mass
Di-2-ethylhexyl phthalate	66·6	,, ,, ,,
Lead stearate	1·5	,, ,, ,,
Cadmium stearate	1·5	,, ,, ,,

The test piece shall be covered with a 75 mm filter paper (Whatman No. 1 or equivalent). The assembly thus obtained shall be sandwiched between two pieces of plate glass 75 mm square and 5 mm thick. A weight of approximately 50 g shall be placed on the top to ensure good contact and the combination shall be placed in an oven and heated for 72 hours at 50 ± 2°C. The control sample and filter paper shall then be removed and examined for stains. The clear control sample shall be examined, first over a white and then over a black background; white filter paper and photo-black cover paper are suitable for this purpose.

APPENDIX E

(*Clause* 4.6)

TEST FOR COLOUR FASTNESS TO LIGHT

E-1. ACCELERATED FADING TEST

E-1.1 Apparatus

E-1.1.1 *Fadeometer* — It shall consist of the following.

E-1.1.1.1 *Source of light* — A carbon arc composed of carbon electrodes and enclosed in a heat-resisting glass globe to produce a complete spectrum from 279 to 1 200 mμ. These should operate on a direct current of approximately 11 to 13A or on alternating current of 50 to 60 c/s and approximately 13 to 17A with 110 to 140 V across the arc.

E-1.1.1.2 The test specimens are vertically hung in test racks on the inner wall of a cylinder (rotating or fixed type), concentric with the arc. The distance of the test specimen shall be approximately 250 mm from the arc. No part of the specimen shall be more than 100 mm above or below the horizontal plane passing through the arc when it is fitted with new electrodes.

E-1.1.1.3 The air inside the chamber is humidified by placing water in a trough or water soaked cotton wicks in the chamber. A fan or blower unit keeps a flow of fresh air over the specimens and through the chamber.

E-1.1.1.4 A black panel thermometer placed in a rack in the chamber shall not record a temperature more than 74°C.

E-1.2 Procedure

E-1.2.1 Place the specimen of suitable dimensions, cut at random from any portion, the sample along with sample No. 5 of the eight standard patterns of plain dyed woollen fabrics as prescribed in IS : 686-1957* at a distance of 250 mm from the carbon arc lamp of fadeometer. Protect half portion of test specimen and the standard woollen cloth No. 5 of the eight standard patterns during the test. Expose face side of the samples to the radiation. Maintain the temperature of the circulating air at about 54°C during the test. The dyed wool standard No. 5 shall be examined often enough at suitable intervals till it shows a fading equivalent to grade 4 on geometric grey scale. After the exposure, the specimen shall be cooled for about an hour, and cleaned. The exposed portion shall be examined in a good light against a white background for fading of colour, as compared with the unexposed portion.

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*Method for determination of colour fastness of textile materials to daylight.

E-2. TEST FOR COLOUR FASTNESS TO DAYLIGHT

E-2.1 Form of Test Specimen — The specimen may conveniently be a piece of sheet of approximate dimensions 130 mm in length and 50 mm in width.

E-2.2 Number of Test Specimens — One specimen shall be used. More may be required for materials that are not of a uniform colour.

E-2.3 Apparatus — The exposure case shall consist essentially of an open-bottomed box of approximate dimensions 900 mm in length, 600 mm in width and 50 mm in depth, covered with a framed lid of glass and containing within it a removable rectangular rack (for carrying the test specimens and wool standards) resting upon a support made of wire mesh.

The details of each of these components are as follows:

a) *Lid* — The lid of the exposure case shall consist of a framed sheet of window glass 3 mm thick without cross supports, having a free area at least 880 mm long and 550 mm wide. When in position its lower surface shall be 25 mm from the upper surface of the rack; it shall be supported in the centre by the 25 mm distance piece described below.

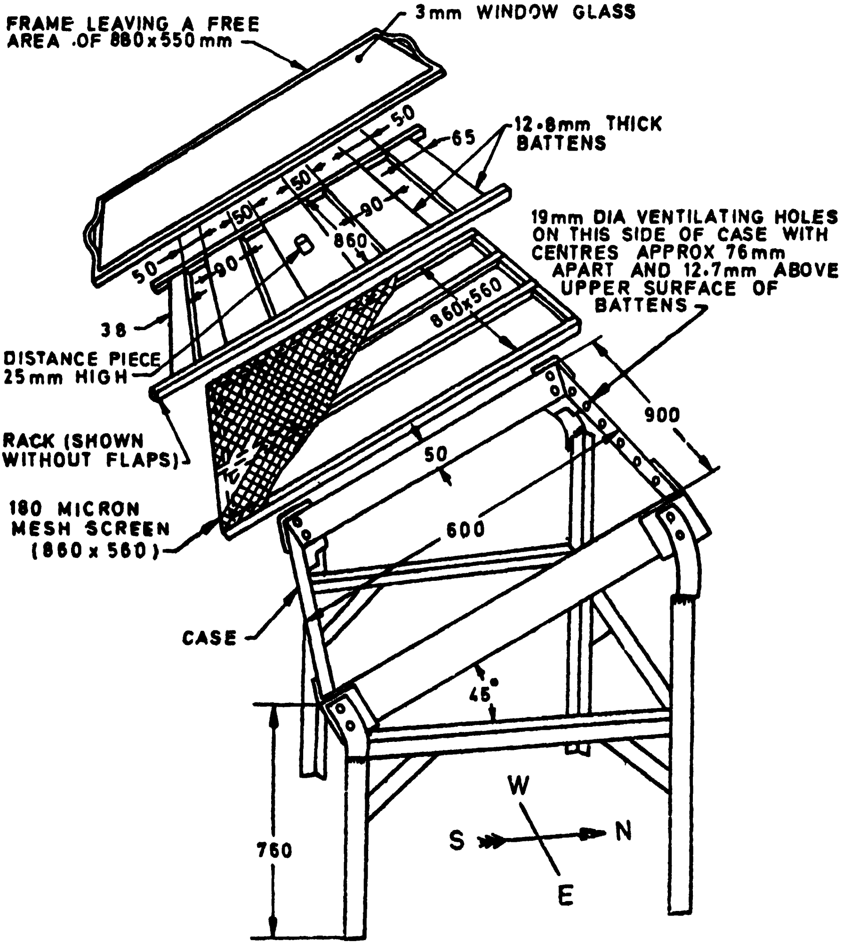
The lid shall fit snugly and symmetrically on to the case.

b) *Rack* — The removable rectangular rack shall consist of five wooden battens attached to cross-members as shown in Fig. 2. The upper and lower batten shall be 64 mm and 38 mm wide respectively and the three middle battens shall each be 90 mm wide. The battens shall be 12·5 mm thick, 50 mm apart and shall be arranged so that there is an air space 860 mm long and 50 mm wide between them. A small wooden piece 25 mm long shall be suitably placed on the upper face of the middle batten.

A series of 50 mm wide wooden flaps shall be so hinged to each batten (except the 38 mm batten) that the lower 50 mm strip of each batten may be covered. The hinges shall be so arranged that (a) when each flap is held parallel to the batten there shall be a space of 1·6 mm between flap and batten; and (b) when each flap is allowed to fall freely, its lower edge will rest upon the batten.

The rack shall fit snugly into the exposure case. When in position the lower surface of the rack shall rest immediately on the upper surface of the wire mesh of the screen.

c) *Wire screen* — The wire screen shall be carried by a removable rectangular frame incorporating two narrow cross supports, dividing the length of the frame into three equal sections. The wire screen, which shall be of 80 × 30 (180 micron) woven wire cloth complying with IS : 2405-1963* shall be fixed to the upper side of the frame so that an area 860 mm long and 560 mm wide of the screen is free from obstruction (except for the cross supports). The frame shall fit snugly into the exposure case.


FRAME LEAVING A FREE AREA .OF 880x550 mm
3mm WINDOW GLASS
50
65
12·8mm THICK BATTENS
50
50
50
90
860
50
90
38
DISTANCE PIECE 25mm HIGH
19mm DIA VENTILATING HOLES ON THIS SIDE OF CASE WITH CENTRES APPROX 76mm APART AND 12·7mm ABOVE UPPER SURFACE OF BATTENS
860x560
900
RACK (SHOWN WITHOUT FLAPS)
50
180 MICRON MESH SCREEN (860 x 560)
600
CASE
45°
760
W
S
N
E

All dimensions in millimetres.

FIG. 2 APPARATUS FOR DAYLIGHT EXPOSURE

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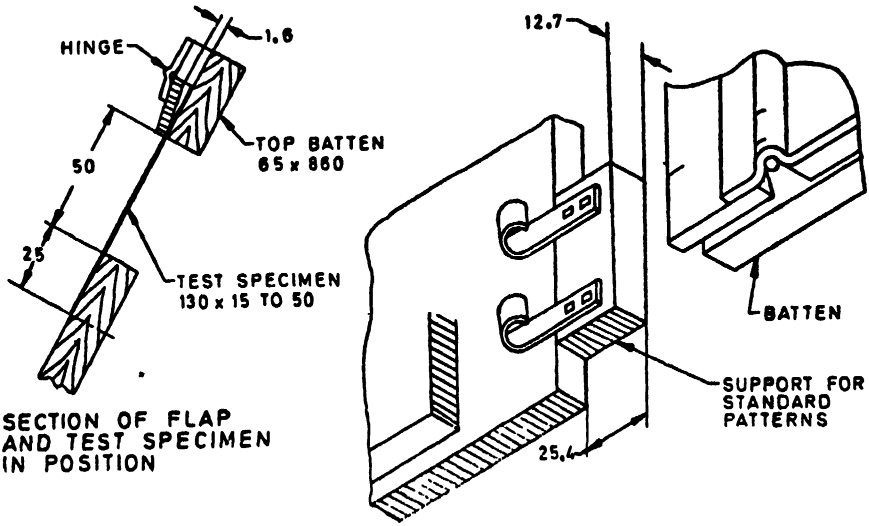
*Specification for wire cloth and perforated plates for industrial use.

The case shall be situated in the open and facing south. It shall be so supported on legs that its lower front edge is 760 mm from the ground. The lid, rack and screen shall all be inclined at 45° to the horizontal. The exposure case shall be so placed that no obstruction in an easterly, southerly or westerly direction shall subtend a vertical angle greater than 20° nor shall any in a northerly direction subtend a vertical angle greater than 70°.

E-2.4 Procedure — Test specimens shall be fixed at the top and bottom on the rack so that the upper 50 mm are covered by the flap, the next 50 mm are freely exposed and the remaining 25 mm rests on the next lower batten. Each specimen shall be placed neither less than 6·4 mm from any other specimen nor within 6·4 mm of the end of the spaces between the battens, to permit free air circulation round the test specimen.

The dyed wool standards shall be exposed on the same rack. They shall be fixed 6·4 mm apart in a support (*see* Fig. 3) so that 38 mm of each standard is covered by the flap, the next 25 mm is freely exposed and the remaining 12·7 mm rests on the lower edge of the support.



SECTION OF FLAP
AND TEST SPECIMEN
IN POSITION

All dimensions in millimetres.

FIG. 3 DETAILS REGARDING MOUNTING OF SPECIMENS AND WOOL STANDARDS

The test specimen and the dyed wool standards so mounted shall be exposed to daylight for a sufficient time to cause Standard No. 4 of IS : 686-1957* to change colour so that the exposed portion of that standard shall have a contrast with the unexposed portion equal to Grade 4 on the Geometric Grey Scale.

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*Methods for determination of colour fastness of textile materials to daylight.

The dyed wool standard shall be examined often enough to ensure that the specified degree of colour change of Standard No. 4 is observed. The glass lid shall be kept clean during the test.

After the prescribed exposure the specimen shall be removed from the rack, cleaned with soap complying with IS : 285-1974* and cold water, dried and examined indoors in good north light against a white background in comparison with the dyed wool standards.

The colour fastness to daylight of the material under test shall be the number of the dyed wool standard that has changed colour to the same extent as the test specimen.

E-2.5 Report — The report shall state:

1. The colour fastness to daylight of the material
2. The form and dimensions of the test specimen.

APPENDIX F

(*Clause* 4.7)

TEST FOR ADHESION OF PLIES IN LAMINATED SHEETS

F-1. REAGENTS

F-1.1 Ethyl Acetate (*see* IS : 229-1972†)

F-2. PREPARATION OF TEST PIECES

F-2.1 Three circular test pieces of 12 mm diameter shall be cut from the sample with a sharp die, or using a template and a sharp knife or razor, one from the centre and one from near each edge.

F-3. PROCEDURE

F-3.1 The test pieces shall be completely immersed for 15 ± ½ minutes in ethyl acetate contained in a glass beaker and stirred by stirrer at about 60 rev/min. The temperature shall be 27 ± 2°C. At the end of the 15 ± ½ minutes period, the test pieces shall be withdrawn from the solvent and immediately examined for separation, either partial or complete, of the

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*Specification for laundry soap (*second revision*).

†Specification for ethyl acetate.

plies. After withdrawal of the test piece from the solvent, nothing further shall be done to initiate separation of plies.

F-3.2 If any separation of any test piece is observed under the above conditions, the ply adhesion shall be regarded as unsatisfactory.

APPENDIX G

(*Clause* 4.8)

DETERMINATION OF DIMENSIONAL STABILITY

G-1. PREPARATION OF TEST PIECES

G-1.1 Three rectangular test pieces 250 × 6 mm shall be cut from the sample, one from the centre and one from within 75 mm of each of the longitudinal edges of the sample. The 250 mm length shall be parallel to the longitudinal direction of the sample. When the test pieces are taken from a roll, they shall be conditioned at 27 ± 2 C for three hours and then test carried out. The lengths of the test pieces shall be measured to the nearest 0·5 mm and recorded. Care shall be taken to ensure that the test piece remains flat and straight for the measurement of its length. A convenient method of achieving this is to place the test piece in a rectangular groove approximately 300 mm long, 7 mm wide and 2 mm deep. The groove should be in a block of wood or other suitable material with a flat top surface. Length measurements may be made with a transparent rule suitably graduated which fits into the groove.

G-2. PROCEDURE

G-2.1 After measuring, the test pieces shall be immersed for a period of 15 ± 1 minutes in a water-bath maintained at a temperature of 50 ± 2°C. A cage of metal gauge with feet to raise it above the base of the vessel shall be used to keep the test pieces away from the sides and base of the vessel. On removal from the water, the test pieces shall be allowed to cool in air at 27 ± 2°C for at least 15 minutes. Care shall be taken to avoid stretching in handling the test pieces. The lengths of the test pieces shall then be measured to the nearest 0·5 mm and recorded.

G-3. CALCULATION AND REPORT

G-3.1 The change in length of each test piece shall be calculated as a percentage of the original length as follows:

$$\text{Percentage change (shrinkage)} = \frac{\text{Initial length} - \text{final length}}{\text{Initial length}} \times 100$$

The greatest of the three percentage changes in length shall be reported as the change in dimension of the sample at 50°C.

APPENDIX H

(*Clause* 4.9)

TEST FOR ADHESION OF PRINT

H-1. APPARATUS

H-1.1 The apparatus shown in Fig. 4 shall consist of an abrading member 'A' (*see* H-1.2) and a means of clamping the test piece over a plate glass surface *B* in such a manner that the abrading member and the test pieces are capable of relative reciprocating motion in a straight line. The amplitude of reciprocation, that is, the stroke, shall be 100 mm and the apparatus shall be mechanically operated so that the rate of reciprocation shall be 15 ± 2 cycles (each of two stroke) per minute.

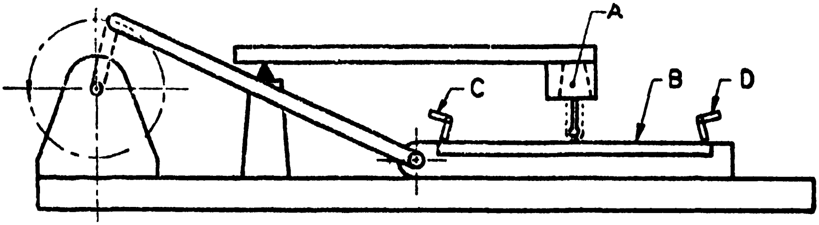

FIG. 4 APPARATUS FOR MEASURING ADHESION OF PRINT

H-1.2 Abrading Member — The abrading member 'A' shown in Fig. 5 shall consist of a brass peg and shall be suitably and firmly secured to the arm of the apparatus so that its centre line is at right angles to the surface of the glass plate. The arm of the apparatus shall be not less than 230 mm in length measured from the centre point of the abrading member to the pivot, and shall be loaded in such a manner that the brass peg exerts a load of 1 kg on the test piece. Means shall be provided for firmly securing a strip of the specified bleached fabric (*see* H-1.3) around the end of the brass peg, a screw clip having been found suitable for this purpose. Suitable grips *C* and *D* shall be provided to ensure that the test piece can be secured firmly across the plate glass surface.

H-1.3 Bleached Cotton Fabric — The bleached cotton fabric shall correspond to variety No. 1 of IS : 177-1970*. Strips of the bleached fabric approximately 50 mm long and 20 mm wide shall be cut with their length parallel to the warp direction.

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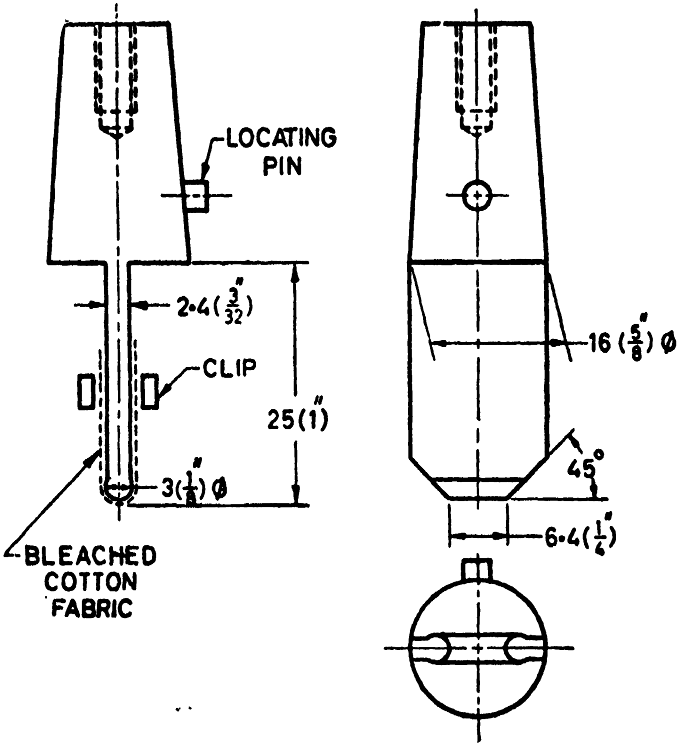
*Specification for cotton drills (*second revision*).



(Dimensions outside the parentheses are in millimetres)

FIG. 5 DETAILS OF ABRADING MEMBER 'A'

H-2. REAGENT

H-2.1 Soap Solution — 0·5 percent (*m/v*) made from soap conforming to Grade 2 of IS : 285-1974*.

H-3. PREPARATION OF TEST PIECES

H-3.1 Not less than three rectangular test pieces 250 × 50 mm shall be cut from the sample with their lengths parallel to the longitudinal direction of the sample. The test pieces shall be cut in such a manner that each contains a portion of the printed design in such a position that it will lie in the path of the abrading member. Where the printed pattern consists of a multi-coloured design, sufficient test pieces shall be prepared

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*Specification for laundry soap (*second revision*).

to enable three tests to be carried out on each colour combination of print. By suitable choice of position of test pieces, it is usually possible to have more than one print colour abraded during any particular test.

H-4. PROCEDURE

H-4.1 The test pieces shall be washed with soap and water, rinsed, and dried. They shall then be conditioned in the room in which the test is to be performed for at least 24 hours before testing and the temperature throughout this period shall be maintained at 27 ± 2°C. Each test piece shall be mounted in turn directly on the plate glass surface. No wrinkling of the test piece shall occur during the test, and it is permissible to stretch the test piece up to 20 percent in the direction of its length to avoid wrinkling. A strip of the bleached fabric shall then be secured to the brass peg. The ribbed side of the fabric shall be in contact with peg. The peg to which the fabric has been fitted shall be lowered on to the test piece. The test piece shall then be subjected to abrasion at the specified rate and the number of cycles required to produce visual damage to the print such as smudging, or removal of the printed pattern on any area of it shall be recorded.

All the test pieces shall be tested in this way and the number of cycles required to remove either the printed pattern or any area of the printed material shall be greater than 5 (10 strokes).

APPENDIX J

(*Clause* 4.10)

BLOCKING TEST

J-1. PREPARATION OF TEST PIECES

J-1.1 Six rectangular test pieces 125 × 75 mm shall be cut from the sample with minimum handling of test piece surfaces. Equal number of rectangular pieces of filter paper (Whatman No. 1 or its equivalent) of 125 × 75 mm, and an equal number of approximately 100 × 75 × 2 mm glass plates shall be conditioned for two hours at 27 ± 2°C.

After conditioning, the test pieces shall be assembled in a pile-like sandwich in the following order with

1. Glass plate
2. Filter paper
3. Test piece face up
4. Test piece face down
5. Filter paper
6. Glass plate

the 75 mm edge of each item superimposed and the test piece and paper consequently extending 25 mm beyond the glass plates at the other edge. This arrangement facilitates handling.

The test shall always be carried back to back as the surface contact will be less if back to face contact is made. In the case of material having very heavy designs, they should be made smooth by heat and pressure and then tested for blocking test.

J-2. PROCEDURE

J-2.1 The assembled pile shall be loaded with 5 kg weight to give a pressure of 0·1 kg/cm^2 and placed in an air-circulating oven. The oven shall be maintained at 50 ± 2°C for 24 hours. After the period the weight shall be removed and the assembled pile taken out and kept at 27 ± 2°C for at least two hours. (The layers shall then be removed successively by application of a slow and uniform pull.)

A mass (50 g for unprinted, 100 g for printed) shall be attached to the free end of the lower test specimen of each pair and allowed to rest freely on the horizontal plane surface. The free end of the upper specimen shall then be raised at a uniform rate of 25 ± 2·5 mm per second. Specimens are completely separated, and note shall be made as to whether or not, during this operation, the weight is raised out of contact with the plane horizontal surface.

The surface of the specimens that have been in contact with one another shall be examined for visible signs of damage. The material shall be readily separable into individual layer and shall not show blocking.

APPENDIX K

(*Clause* 4.11.2)

METHOD OF DETERMINING PIN HOLES

K-1. TEST PIECE

K-1.1 A 1 m length of the full width of the sheeting shall be taken.

K-2. APPARATUS

K-2.1 The following apparatus is required:

A stretching frame which shall be capable of applying a 20 percent stretch in the longitudinal direction to the test piece across its full width and maintaining the sheeting smoothly supported in a horizontal plane.

K-3. MATERIAL

K-3.1 A 75 mm paint brush.

K-3.2 White unglazed paper such as white sulphite paper approximately 75 mm wider than the test piece.

K-3.3 A suitable frame as shown in Fig. 6.

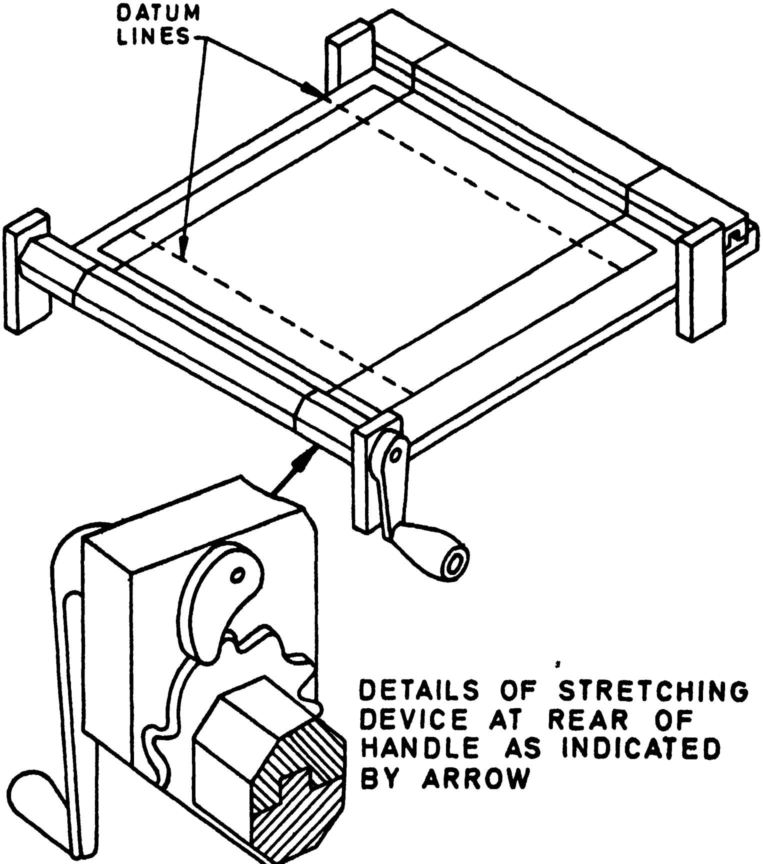
DATUM LINES
DETAILS OF STRETCHING DEVICE AT REAR OF HANDLE AS INDICATED BY ARROW

FIG. 6 FRAME FOR DETERMINING PIN HOLES

K-4. REAGENT

K-4.1 A dye solution made up in the following proportions:

0·25 percent wetting agent,
0·10 percent Rhodamine B,
99·65 percent water.

K-5. PROCEDURE

K-5.1 The test piece shall be fitted in the stretching frame so that it rests smoothly and without creases on the surface of a sheet of unglazed paper on which two parallel lines have been drawn at distance apart equal to

$$\frac{1\cdot20}{\text{Width of test piece}}\ \text{metres}$$

that is, to enclose an area of one square metre under 20 percent stretch. The sheeting shall then be subjected to a 20 percent linear stretch in the longitudinal direction.

Approximately 50 ml of dye solution shall then be poured on the stretched sheeting and spread over the marked area by a continuous brushing action with strokes both parallel and perpendicular to the longitudinal direction for a period of 2 minutes. The sheeting shall then be carefully removed from the clamps and discarded. The number of pin holes in the sheeting appearing as coloured blotches on the recording paper shall be counted and reported as the number of pin holes per square metre.

APPENDIX L

(*Clause* 5.2.2)

DETAILS OF INFORMATIVE LABELLING

A label giving certain particulars about PVC sheeting shall be attached to each roll (*see* **5.2.1**).

In addition, it is recommended that any other useful information should be made available by the manufacturers to users of PVC sheeting (*see* **5.2.2**).

Both of these objectives may be achieved by means of (1) a suitably worded label attached to each roll of PVC sheeting containing information of interest to both fabricators and retailers of PVC sheeting, and (2) a suitably worded leaflet to be made available to retailers for the information of home users of PVC sheeting. Examples of label and leaflet are given below:

An example of an informative label — The following is recommended as suitable for use in informative labels to be attached to rolls of PVC sheeting.

The information is laid out for a two-sided label. Where a stick-on label is used the same information may be provided on one face as desired.

Front Face

PVC SHEETING

Name and/or trade mark of manufacturer

Number of this Indian Standard and the type number of the sheeting

Nominal thickness, width, length and/or net mass, colour, printing, lamination and embossing details of sheeting

Date of manufacture

TO FABRICATORS OF PVC SHEETING

1. It is recommended that articles from PVC sheeting are made in accordance with the relevant Indian Standard specifications.
2. It is recommended that an informative label or leaflet, setting out the points of interest to the user, is attached to all articles made with PVC sheeting.

Items suitable for one's produce can be selected from the TEN POINTS listed on page 29.

TO RETAILERS OF PVC SHEETING

Copies of a free leaflet for giving to each purchaser of PVC sheeting are available on request from......................(manufacturer's name).

This leaflet sets out the various points of interest to the home user of PVC sheeting.

INFORMATIVE LABELLING

The following ten points are useful about article(s) made with PVC sheeting conforming to this standard:

1. It is made with PVC sheeting satisfying this Indian Standard. This sets an acceptable level of quality for the material.
2. It sets a good standard of quality for the method of manufacture.
3. It is mothproof and hygienic. It does not fray.
4. It may be stored away wet without damage.
5. It is not ordinarily harmed by grease or dirt. If it is coiled, wipe it with a damp cloth; if necessary, use soap and warm water and then rinse with cold water.
6. It does not need boiling; this may be harmful. Also, dry cleaning materials should not be used on it.
7. It never needs ironing. Creases fall out on hanging in a warm room.
8. It should not be left too near a fire or radiator. (Very hot saucepans, dishes straight from the oven, or irons, should not be placed directly on it).
9. It is not harmed by frost. It may temporarily stiffen a little in cold weather but it will soften at once on returning to normal temperature.
10. It should not be left in contact with polished surface as some finishes may adhere to PVC material.

The following ten points are suitable for home users of PVC sheetings:

1. PVC sheeting is a fabric having certain special properties. The grade sold with this leaflet has been made to satisfy Indian Standard. This sets an acceptable level of quality.
2. PVC sheeting does not fray and may be cut in any direction. Also its level free edges do not need hemming, but these should be kept free from nicks.
3. PVC sheeting may be sewn by hand or machine. As the material has no wave, however, stitches should be lightly tensioned and no closer than 8 to 10 per 2·5 cm, otherwise the thread may cut through the material. Tacking stitches should be avoided wherever possible, but if they are used a fine needle and fine thread are

preferable. Seams should preferably be arranged with and not across the direction of strain, and should be backed with tape or bias binding.

4. PVC sheeting is waterproof; it may be stored away wet without damage.

5. PVC sheeting is mothproof and hygienic. It is not ordinarily harmed by grease or ordinary dirt, which can only lie on its surface. If it is soiled, wipe it with a damp cloth; if necessary, use soap and warm water and then rinse with cold water.

6. Boiling is quite unnecessary and may be harmful. Also dry-cleaning materials should not be used on PVC sheeting.

7. Creases fall out on hanging in a warm room. PVC sheeting never needs ironing.

8. PVC sheeting should not be left too near a fire or radiator. Very hot saucepans, dishes straight from the ovens, or irons should not be placed directly on it.

9. PVC sheeting is not harmed by frost. It may stiffen a little in cold weather but it will soften at once on returning to normal temperature.

10. It is advisable not to leave PVC sheeting in contact with polished surfaces as some finishes may adhere to this material.

(*Continued from page* 2)

Unsupported PVC Sheets Subcommittee, PCDC 12 : 5

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AMENDMENT NO. 1 MAY 2002
TO
IS 2076 : 1981 SPECIFICATION FOR UNSUPPORTED FLEXIBLE POLYVINYL CHLORIDE SHEETING

(First Revision)

(*Page* 7, *clauses* **6** *and* **6.1**) — Substitute the following for the existing:

'6 CONDITIONING AND STORAGE

6.1 Conditioning

6.1.1 For all test purpose minimum time between manufacture and testing shall be 16 h, in order to remove stresses and attain dimensional stability.

6.1.2 Sample shall be conditioned for 16 h minimum at standard atmosphere at a temperature of 27 ± 2°C and relative humidity 65 ± 5 percent before tests.

6.1.3 Unless otherwise specified, testing shall be carried out at 27 ± 2°C and relative humidity 65 ± 5 percent.

6.1.4 For product test, the time between manufacture and testing shall not exceed six months.

6.2 Storage

The roll of unsupported flexible polyvinyl chloride sheeting complying with this standard shall be stored vertically on dry, clean, firm level ground and at recommended temperatures in accordance with the manufacturer's instructions. The rolls shall be protected from dust, moisture, direct sunlight, corrosive and solvent fumes.'

(*Page* 10, *clause* **B-1.1**, *Note*) — Substitute the following for the existing:

'NOTE — It is recommended that the load scale/load cell be suitably calibrated atleast once every twelve months.'

(*Page* 18, *clause* **E-2.3**(c), *line* 1) — Substitute 'IS 2405 (Part 1):1980' *for* 'IS 2405:1963'.

(*Page* 18, *footnote*) — Substitute the following for the existing:

'*Industrial sieves: Part 1 Wire cloth sieves (*first revision*)'

Amend NO. 1 to IS 2076 : 1981

(*Page* 19, *clause* E-2.4, *third para*) — Substitute 'IS 686 : 1985' *for* 'IS 686 : 1957*'

(*Page* 19, *footnote*) — Insert '(*first revision*)' at the end.

(PCD 12)

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